

ACCESSION #: 9710240048
NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Catawba Nuclear Station, Unit 2 PAGE: 1 OF 8

DOCKET NUMBER: 05000414

TITLE: Reactor Trip Due to Closure of a Main Steam Isolation Valve

EVENT DATE: 02/21/95 LER #: 95-001-01 REPORT DATE: 10/16/97

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: RL Bain, Safety Review Group Manager TELEPHONE: (803) 831-3743

COMPONENT FAILURE DESCRIPTION:

CAUSE: F SYSTEM: SB COMPONENT: OB MANUFACTURER: E169
REPORTABLE NPRDS: Yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On February 21, 1995, at 2153 hours, Unit 2 was in Mode 1, Power Operation at 100%, when an automatic Reactor/Turbine Trip occurred on Over Power Differential Temperature after the Main Steam Isolation Valve (MSIV) for "B" Steam Generator (S/G) closed unexpectedly. Following the trip, a Main Feedwater System isolation occurred as a result of a reactor trip with low Reactor Coolant (NC) System average temperature (T-ave). Auxiliary Feedwater (CA) System motor driven and turbine driven pumps autostarted as expected due to lo-lo steam generator levels. Following reset of the CA System, NC T-ave increased above no-load setpoint allowing the Steam Dump System to actuate which resulted in S/G level decreasing below lo-lo level setpoint causing a second CA System turbine driven pump autostart. Engineering is evaluating transient data and will provide operations with recommendations concerning maintaining S/G levels following transients. The MSIV closure was caused by a degraded optical isolator within the control circuitry for the MSIV. Corrective Actions included testing and replacing degraded isolators in the control circuitry for all MSIVs and in critical

applications in other systems for both units. The degraded optical isolators were returned to the vendor for testing. Engineering is evaluating reliability improvements of optical isolators and developing a trending program for optical isolators. All safety systems responded as designed to shutdown the Reactor and maintain it in a safe shutdown condition.

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BACKGROUND

Main Steam Isolation Valves [EII:V] (MSIV) provide steam isolation for the Steam Generators [EII:HX] (S/Gs) during shutdown and accident conditions.

The Main Steam Vent to Atmosphere System [EII:VL] (SV) S/G safety valves provide over pressure protection for Main Steam System [EII:SB] (SM). There are five valves per steam line and provide 100% steam relief capacity.

The Main Feedwater [EII:SJ] (CF) system consists of two steam driven feedwater pumps [EII:P], two stages of high pressure feedwater heaters [EII:HTR] (A and B), piping [EII:PSP], valves, and instrumentation. Normally, both feedwater pumps will be operating with each pump handling half the feedwater flow. Downstream of the feedwater pumps, the feedwater passes through two stages of high pressure heaters to a final header where the temperature is equalized. The feedwater is then admitted to the steam generators through four steam generator feedwater lines, each of which contains a control valve and a flow nozzle [EII:NZL].

The purpose of the feedwater isolation signal is to initiate isolation of each steam generator and rapidly terminate feedwater flow and steam blowdown inside containment [EII:NH] following a main steam or feedwater line break in containment, and to prevent overfilling the steam generators if for some reason the normal means of controlling steam generator level malfunctions. Feedwater isolation is activated by any one of the following signals: safety injection, reactor trip plus low average reactor coolant temperature (T-ave less than 564 degrees F), or Hi-Hi Steam Generator level. A feedwater isolation signal closes the Feedwater Isolation Valves, Feedwater Purge Valves, Feedwater Control Valves, Feedwater Control Bypass Valves, Feedwater Preheater Bypass Valves, and Feedwater Bypass Tempering Flow Valves.

The Auxiliary Feedwater [EII:BA] (CA) System assures sufficient feedwater supply to the steam generators in the event of loss of the CF

System, to remove primary coolant stored and residual core energy. The system is designed to start automatically in the event of loss of offsite electrical power, trip of both CF pumps, safety injection signal, or lo-lo steam generator water level; any of which may result in, coincide with, or be caused by a Reactor trip. In addition, the CA System will supply sufficient feedwater flow to maintain the Reactor [EIS:RCT] at hot standby for two hours followed by cooldown of the Reactor Coolant [EIS:AB] (NC) System to the temperature at which the Residual Heat Removal [EIS:BP] (ND) System may be operated.

The Over Power Differential Temperature (OPDT) trip setpoint protects against excessive fuel centerline temperature. The OPDT is continuously calculated by

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analog circuitry for each loop and depends on the temperature in the loop and the neutron flux distribution in the Reactor.

The Reactor Protection System [EIS:JC] (IPX) is designed to trip the Reactor or actuate appropriate safeguards equipment in time to prevent violating any plant safety limits. A Reactor Trip signal is generated when 2/4 NC system loops have exceeded their calculated OPDT setpoint.

EVENT DESCRIPTION

February 21, 1995 Unit 2 was in Mode 1, Power Operation at 100% power.

2153:47 S/G "B" MSIV began going closed.

2153:49 S/G "B" MSIV was completely closed.

2153:55 Safety relief valves on "B" Main Steam Line opened to control pressure.

153:59 An Automatic Reactor Trip occurred on Unit 2 due to two out of four NC System Loops exceeding OPDT setpoint. Main Turbine tripped as a result of the Reactor Trip.

154:10 Safety relief valves on "B" Main Steam Line closed.

154:13 CA System Motor Driven Pumps autostarted due to lo-lo level in two out of four channels on "B" S/G.

154:15 Main Feedwater System isolation occurred due to

Reactor Trip with low T-ave (below 564 degrees Fahrenheit).

154:19 CA System Turbine Driven Pump autostarted due to lo-lo level in two out of four channels on "B" and "D" S/Gs.

158:30 CA System was reset.

210:48 Lo-Lo S/G signal for "A", "C", and "D" S/G cleared. CA Turbine Driven Pump was armed due to only one S/G being below S/G lo-lo setpoint.

2211 Steam Dump System actuated due to NC System T-ave increasing above no-load temperature setpoint. Steam Dump System actuation caused S/G levels to decrease.

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2211:13 Second CA System Turbine Driven Pump autostart occurred due to lo-lo level in two out of four channels on "A" and "B" S/G.

2212:30 CA System was reset.

2216 All S/G levels stable with Unit 2 in mode 3.

CONCLUSION

The Reactor Trip was due to OPDT setpoints being exceeded as a result of the unexpected closure of MSIV for "B" S/G. The MSIV closure was caused by a degraded optical isolator within the control circuitry for the MSIV. Engineering replaced the faulty optical isolator (E-max model number 175C156) and elected to conservatively replace all the relays and an additional optical isolator, of the same type, that could have caused the failure in the MSIV control circuit for "B" S/G. The remaining MSIV control circuits for Unit 2 were inspected to evaluate whether any of circuits contained degraded components. The inspection revealed that four additional optical isolators (E-max model number 175C156) were degraded. All of the degraded optical isolators were replaced and the new optical isolators were successfully tested. The degraded optical isolators were returned to the vendor for testing.

Engineering reviewed other critical circuits for Unit 2 systems [Main Steam System [EIS:SB] (SM), Main Feedwater System [EIS:SJ] (CF), Condensate System [EIS:KA] (CM), Nuclear Service Water System [EIS:BI]

(RN), Auxiliary Feedwater System [EIS:BA] (CA), Reactor Coolant System [EIS:AB] (NC), Chemical and Volume Control System [EIS:CB] (NV), and Safety Injection System [EIS:BQ] (NI) that may utilize optical isolators in a control application that would result in a plant trip or a transient that would likely cause a trip. In the circuits reviewed, there were a total of 23 optical isolators identified in critical applications. The twenty-three isolators were tested and all were within the manufacturer specifications.

Engineering reviewed the failure history of E-max optical isolators model number 175C155, 175C156, and 175C157. All of the degraded isolators that failed in the Unit 2 MSIV circuitry were model number 175C156. A search of optical isolators revealed model numbers 175C156 and 175C157 had a higher replacement rate when compared to other optical isolators at Catawba Nuclear Station (CNS), particularly in the Main Steam System and Main Feedwater System. The supplier of optical isolator model numbers 175C156 and 175C157 could not provide CNS with a predicted replacement rate. Both of these isolator models are digital isolators with AC inputs and DC outputs. Model number 175C155 is a digital isolator with a DC input with AC output. This model isolator showed a very low replacement rate.

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Planned Corrective Actions include testing optical isolators in Unit 1 MSIV circuits, testing isolators in critical applications for critical circuits on Unit 1 systems (SM, CF, CM, RN, CA, NC, NV, NI), replacing degraded isolators, developing a Periodic Maintenance program for replacement of optical isolators (E-max model number 175C156 and 175C157) which perform a control function and have AC voltage for their input power supply, evaluating reliability improvements of optical isolators, and develop a trending program for optical isolators. The optical isolator failure is NPRDS reportable.

Following the Unit 2 trip, Operators reset the CA System and were maintaining S/G level at approximately forty percent by throttling flow to S/Gs. When NC T-ave increased above no-load setpoint, the Steam Dump System actuated bringing T-ave back to no-load setpoint. The Steam Dump System actuation caused S/G levels to decrease below lo-lo setpoints resulting in a second CA System Turbine Driven Pump autostart. The autostart occurred due to level in "A" and "D" S/G decreasing below lo-lo setpoint of 36.8 percent. Engineering is evaluating transient data and will provide Operations with recommendations concerning maintaining S/G levels following transients. Operations Management discussed the incident with operators and reviewed data concerning S/G levels that were being maintained during the transient. Management concluded that the

difference in Unit 1 (17 percent) and Unit 2 (36.8 percent) S/G lo-lo level setpoints could have attributed to S/G levels being maintained close to Unit 2 lo-lo S/G setpoint. Operations training will develop training that will focus more attention on the difference in S/G lo-lo setpoints between Unit 1 and Unit 2. Engineering recommendations and Operator training will help reduce CA System autostarts due to lo-lo S/G levels after CA System is reset.

During this event, Control Room Operators (CROs) entered the correct emergency response procedures and performed the required steps to maintain the plant in a safe shutdown condition. All safety systems responded as designed.

A review of the Operating Experience Program for the twenty-four months prior to this event revealed a previous Unit 2 Reactor Trip due to closure of a MSIV. LER 414/94-006 involved a Unit 2 Reactor Trip when MSIV for "C" S/G closed unexpectedly due to a short circuit in a normally energized coil in a D26 Cutler Hammer relay. Since these two trips involved failure of different components, and the Corrective Actions for LER 414/94/-006 would not have prevented this trip, this event is considered not to be recurring.

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CORRECTIVE ACTIONS

IMMEDIATE

- 1) CROs entered procedure EP/2/A/5000/E-O, Reactor Trip or Safety Injection to verify the plant responded properly and to assess plant conditions.
- 2) CROs entered procedure EP/2/A/5000/ES-O.1, Reactor Trip Response, per EP/2/A/5000/E-O.

SUBSEQUENT

- 1) IAE and Engineering investigated why the MSIV unexpectedly closed. A degraded optical isolator was discovered and replaced. The relays and an additional optical isolator (model number 175C156) in the circuit were conservatively replaced even though they met manufacturers' specifications when tested. The replacement optical isolators and relays were successfully tested. The work was performed under Work Order (W/O 95016298-01).

2) The remaining MSIV control circuits for Unit 2 were inspected for degraded components. Degraded optical isolators were replaced and the replacements were successfully tested. The work was performed under Work Orders (95016755-01, 95016759-01, 95016976-01).

3) Testing was conducted on the degraded optical isolators that were removed from the Unit 2 MSIV circuits. Testing revealed a failure within the internal circuit of the optical isolators.

4) Testing was performed on twenty-three optical isolators that were identified by Engineering to be in critical applications on Unit 2 systems (SM, CF, CM, RN, CA, NC, NV, NI). All of the optical isolators were within the manufacturers' specifications. The work was performed under Work Request (95011132).

5) Engineering reviewed failure history of E-max model number 175C155, 175C156, and 175C157. Model numbers 175C156 and 175C157 indicated a high replacement rate when compared to other optical isolators at CNS. Model number 175C155 indicated a low replacement rate.

6) Degraded optical isolators were returned to the vendor for testing.

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PLANNED

1) Test optical isolators in Unit 1 MSIV control circuits and in critical circuits for critical applications on Unit 1 systems (SM, CF, CM, RN, CA, NC, NV, NI). Replace degraded optical isolators and test the replacements.

2) Develop a PM program to replace E-max model number 175C156 and 175C157 optical isolators prior to reaching the end of their expected service life. The scope of the PM program will include all optical isolators which perform a control function Hm and have AC voltage for their input power supply .

3) Evaluate reliability improvements for critical control circuits that have E-max model numbers 175C156 and 175C157 optical isolators.

4) Develop a trending program to monitor the performance of

optical isolators using the recent testing and measurements as the baseline data.

5) Engineering will evaluate transient data concerning S/G levels and will provide recommendations to Operations concerning maintaining S/G level following transients.

6) Operations training will develop training that will focus more attention on the difference in S/G lo-lo level setpoints between Unit 1 and Unit 2.

SAFETY ANALYSIS

This event was initiated due to an unexpected closure of a main steam isolation valve 2SM5 which resulted in a Reactor/Turbine Trip on Overpower Differential Temperature. These events are bounded by the Safety Analysis documented in the FSAR Sections 15.2.4, Inadvertent Closure of Main Steam Isolation Valves, and 15.2.3, Turbine Trip.

Safety relief valves on Main Steam Line for "B" S/G opened to control pressure. CA system motor driven and turbine driven pumps autostarted due to lo-lo levels in "B" and "D" S/Gs. CF Isolation occurred due to Reactor trip with low NC system T-ave. Following reset of CA System, NC T-ave increased above no-load setpoint allowing Steam Dump System to actuate which resulted in S/G level decreasing below lo-lo level setpoint causing a second CA System turbine driven pump auto start. S/G levels returned to normal. NC System cooldown

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experienced during this event is bounded by the Safety Analysis in Section 15.1.5, Steam System Piping Failure.

During this event, all systems responded as designed to shutdown the reactor and maintain it in a safe shutdown condition. There were no unusual releases of radioactive material.

The health and safety of the public were not affected by this event.

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